SOLID HIGH POLYMER ELECTROLYTE FUEL CELL

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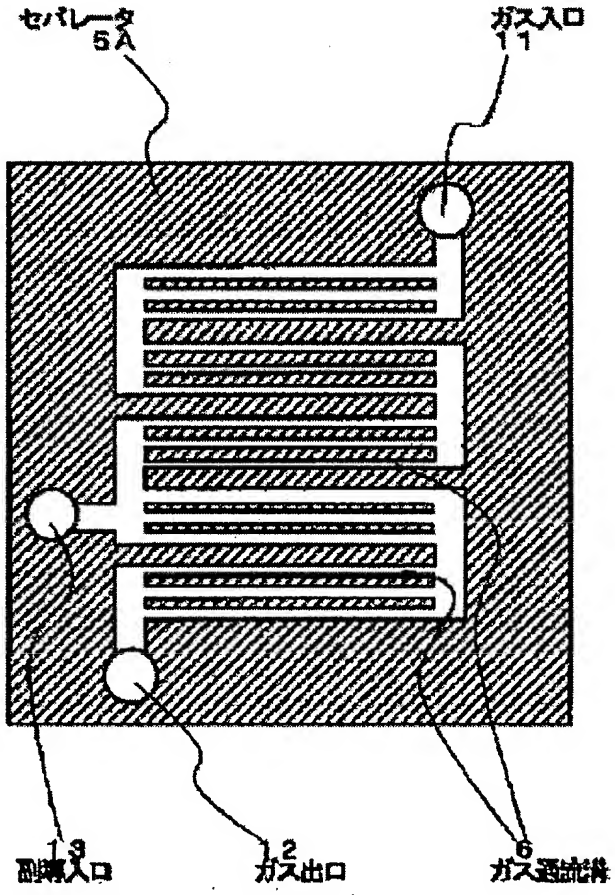
Abstract of **JP10284095**

PROBLEM TO BE SOLVED: To effectively suppress condensation of water produced with power generation to a gas conduction groove, and operate stably. SOLUTION: A gas conduction groove 6 is positioned in a power generation area in opposition to an electrode of a separator 5A, and in a construction in which reactive gas introduced from a gas inlet 11 is passed to the gas conduction groove 6, and after using it for power generation by electrochemical reaction, it is exhausted from a gas outlet 12, the second reactive gas is supplied by providing an auxiliary inlet 13 connected to an intermediate part of the gas conduction groove 6.



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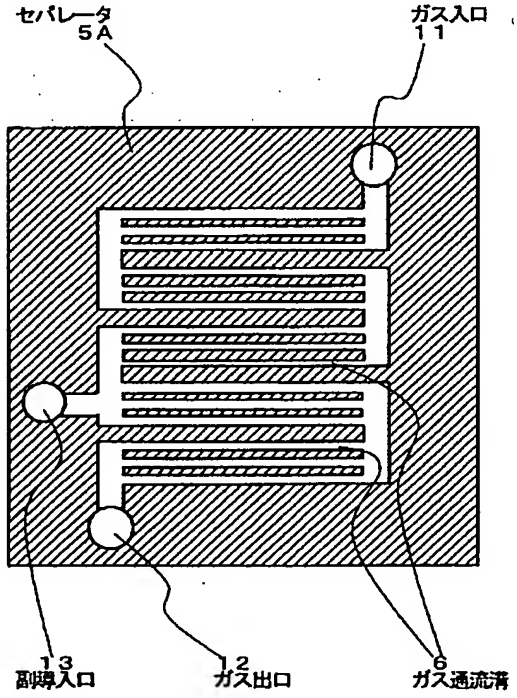
(54)【発明の名称】　固体高分子電解質型燃料電池

(57)【要約】
【課題】発電にともない生じる生成水のガス通流溝への凝縮が効果的に抑制され、安定して運転できるものとする。
【解決手段】セパレータ５Ａの電極と対向する発電領域にガス通流溝６を配し、ガス入口１１より導入した反応ガスをガス通流溝６に通流させて電気化学反応による発電に用いたのち、ガス出口１２より排出するものにおいて、ガス通流溝６の中間部分へと連通するガスの副導入口１３を設けて、第２の反応ガスを供給する。



【特許請求の範囲】

【請求項１】平板状の固体高分子電解質膜の両主面に電極を配して形成された電解質膜電極接合体と、電解質膜電極接合体の電極に対向して反応ガス通流溝を備えたガス不透過性材料よりなるセパレータを積層して構成し、セパレータに備えたガス入口より反応ガスを導入し、反応ガス通流溝を通流させて電気化学反応により発電させ、セパレータに備えたガス出口より排出する固体高分子電解質型燃料電池において、セパレータに、前記の反応ガス通流溝の中間部分へと連通して第２の反応ガスを導入する副導入口を備えたことを特徴とする固体高分子電解質型燃料電池。

【請求項２】請求項１に記載の固体高分子電解質型燃料電池において、副導入口より導入される前記の第２の反応ガスが乾燥した反応ガスであることを特徴とする固体高分子電解質型燃料電池。

【請求項３】請求項１に記載の固体高分子電解質型燃料電池において、副導入口より導入される前記の第２の反応ガスが加湿した反応ガスであることを特徴とする固体高分子電解質型燃料電池。

【請求項４】平板状の固体高分子電解質膜の両主面に電極を配して形成された電解質膜電極接合体と、電解質膜電極接合体の電極に対向して反応ガス通流溝を備えたガス不透過性材料よりなるセパレータを積層して構成し、セパレータに備えたガス入口より反応ガスを導入し、反応ガス通流溝を通流させて電気化学反応により発電させ、セパレータに備えたガス出口より排出する固体高分子電解質型燃料電池において、ガス入口と反応ガス通流溝の中間部分との間に、反応ガスを分流する分岐通流溝を備えたことを特徴とする固体高分子電解質型燃料電池。

【請求項５】請求項４に記載の固体高分子電解質型燃料電池において、電解質膜電極接合体のアノード側の電極に対向するセパレータの反応ガス通流溝に通流させる反応ガスを加湿した反応ガスとし、カソード側の電極に対向するセパレータの反応ガス通流溝に通流させる反応ガスを乾燥した反応ガスとしたことを特徴とする固体高分子電解質型燃料電池。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、固体高分子電解質膜を電解質として用いる固体高分子電解質型燃料電池のセル構造、特にセパレータに形成する反応ガスの流路の構成に関する。

【０００２】

【従来の技術】固体高分子電解質型燃料電池は固体高分子電解質膜の二つの主面に、それぞれアノード電極とカソード電極を配して形成される。アノードおよびカソード電極は、いずれも電極基材の上に電極触媒層を配して形成され、固体高分子電解質膜には、スルホン酸基を持つポリスチレン系の陽イオン交換膜をカチオン導電性膜として使用したもの、あるいは、パーフルオロスルホン酸樹脂膜などが用いられる。

【０００３】固体高分子電解質膜は、分子中にプロトン（水素イオン）交換基を有し、飽和に含水させることにより常温で 20 Ω・cm以下の比抵抗を示し、プロトン導電性電解質として機能する。電極基材は、多孔質体で、燃料電池の反応ガス供給、排出手段、および集電体として機能する。アノードおよびカソード電極においては、気・液・固相の三相界面が形成され、電極触媒の触媒作用により、それぞれ次式（１）、（２）の電気化学反応が起きる。

【０００４】

【化１】

$$\text{アノード電極} \quad ; \quad H_2 = 2H^+ + 2e \qquad (1)$$

$$\text{カソード電極} \quad ; \quad (1/2)O_2 + 2H^+ + 2e = H_2O \qquad (2)$$

すなわち、アノード電極においては、系の外部より供給されたH_2 ガスからプロトンと電子が生成する。生成したプロトンは、イオン交換膜内をカソード電極へ向かって移動し、電子は外部回路を経てカソード電極へ移動する。一方、カソード電極においては、系の外部より供給されたO_2 ガスと、イオン交換膜内をアノード電極より移動してきたプロトン、および外部回路より移動してきた電子とが反応し、H_2Oを生成する。

【０００５】図３は、従来の固体高分子電解質型燃料電池のセル構造を示す断面図である。電極基材３の上に電極触媒層２が積層されて電極４が構成される。電極４を固体高分子電解質膜１の両主面に配置し、ホットプレスにより熱圧着して電解質膜電極接合体９が形成される。このように固体高分子電解質膜１に電極４が配置された電解質膜電極接合体９は、両側に積層されるセパレータ５により挟持して固定される。セパレータ５は、カーボン板材を機械加工して形成されており、反応ガス通流溝６ならびに冷却水通流溝７を備えている。アノード電極側のセパレータ５の反応ガス通流溝６には燃料ガス（水素ガス）が、また、カソード電極側のセパレータ５の反応ガス通流溝６には酸化剤ガス（空気）が流される。固体高分子電解質膜１が乾燥して水分を失うと、高抵抗となり抵抗損失が増大して電池特性が低下する。このため、反応ガスを加湿したのち供給することにより固体高分子電解質膜１の乾燥を防止している。またセパレータ５にはガスケット挿入陽の溝が備えられており、ガスケット８を装着することにより、反応ガスの電池外部への漏洩を防止している。

【０００６】電極４を構成する電極基材３には、一般に、多孔質のカーボンペーパーが用いられており、反応ガス通流溝６に燃料ガス、あるいは酸化剤ガスを供給すると、これらの反応ガスは電極基材３中を拡散して電極

触媒層２へと到達し、上述の電気化学反応を生じる。電気化学反応により生成した電子は、電極基材３により集電され、さらにセパレータ５を経て、外部回路へと出力され、消費される。

【０００７】図４は、上記のセルのセパレータ５に形成されているガス流路の形状を示す断面図である。反応ガスは、セパレータ５の上部に配されたガス入口１１より導入され、電解質膜電極接合体９の電極４に対応する発電領域に配されたガス通流溝６を下方へと通流して電気化学反応を生じ、発電に寄与したのち、残余のガスはガス出口１２より外部へ排出される。

【０００８】

【発明が解決しようとする課題】反応ガスは、ガス入口１１よりガス出口１２へと進むに従い、電気化学反応を生じて消費されるため、流量が減少し、流速が低下する。また、酸化剤の空気または酸素ガスが供給されるカソード側のセパレータ５においては、電気化学反応に伴って水が生成され、下流側に行くにしたがい生成水が累積するので、ガス出口１２に近い領域では水が凝縮しやすくなる。さらに上記のように下流側ではガスの流速も低下するので、凝縮した生成水によってガス通流溝６が閉塞されたり、あるいは水が溝の壁面に付着し、滞留する現象が生じる危険性がある。このように、ガス通流溝６に水が凝縮する状態になると、電極４を構成する電極基材３あるいは電極触媒層２が水に濡れ、多孔質体の空孔が水で覆われるので、電極触媒層２への反応ガスの拡散が阻害されて、電池特性が低下する事態が起きることとなる。

【０００９】本発明の目的は、発電に伴い生じる生成水の反応ガス通流溝への凝縮が効果的に抑制され、安定して電池出力が得られる固体高分子電解質型燃料電池を提供することにある。

【００１０】

【課題を解決するための手段】上記の目的を達成するために、本発明においては、平板状の固体高分子電解質膜の両主面に電極を配して形成された電解質膜電極接合体と、電解質膜電極接合体の電極に対向して反応ガス通流溝を備えたガス不透過性材料よりなるセパレータを積層して構成し、セパレータに備えたガス入口より反応ガスを導入し、反応ガス通流溝を通流させて電気化学反応により発電させ、セパレータに備えたガス出口より排出する固体高分子電解質型燃料電池において、

（１）セパレータに、前記の反応ガス通流溝の中間部分へと連通して第２の反応ガスを導入する副導入口を備え、乾燥した反応ガスあるいは加湿した反応ガスを導入することとする。

【００１１】（２）あるいは、ガス入口と反応ガス通流溝の中間部分との間に、反応ガスを分流する分岐通流溝を備え、例えば、アノード側の電極に対向する反応ガス通流溝に加湿した反応ガスを、またカソード側の電極に対向する反応ガス通流溝に乾燥した反応ガスを通流することとする。

上記の（１）のごとく副導入口を設けて、第２の反応ガスとして乾燥した反応ガスを供給すれば、電気化学反応に伴って生成された水が水蒸気として保持されることとなるので、水の凝縮が防止され、電池特性の低下が回避される。また、第２の反応ガスとして加湿した反応ガスを供給すれば、この反応ガスの調整により反応ガス通流溝の加湿条件を容易に変動させることができるので、水の凝縮が防止され、電池特性の低下が回避されるばかりでなく、セル温度の変動が生じても容易に安定出力を維持させることが可能となる。

【００１２】また、上記の（２）のごとく分岐通流溝を備えて、反応ガス通流溝の中間部分に分流した反応ガスを供給することとすれば、水分量の少ない反応ガスの導入により水の凝縮が抑制されることとなる。とくに、アノード側の電極に対向する反応ガス通流溝に加湿した反応ガスを、またカソード側の電極に対向する反応ガス通流溝には乾燥した反応ガスを供給することとすれば、アノード側は一定して加湿状態が保持され、一方カソード側では、電気化学反応に伴い生じる生成水により加湿され、かつ、反応ガス通流溝の中間部分より導入される反応ガスによって水の凝縮が抑制されるので、ガス通流溝の凝縮水による閉塞や、凝縮水の溝の壁面への付着、滞留を生じることなく、残余の反応ガスは外部へと排出される。

【００１３】

【発明の実施の形態】

＜実施例１＞図１は、本発明による固体高分子電解質型燃料電池の実施例１のセルのセパレータに形成されたガス流路の形状を示す断面図である。本実施例のセパレータ５Ａに備えられたガス流路の特徴は、ガス通流溝６の中間部分に連通する副導入口１３が備えられている点にある。本構成では、加湿された反応ガスがガス入口１１より導入され、電極部に対応して蛇行して配されたガス通流溝６を通流し、ガス出口１２より排出される。同時に、第２の反応ガスとして乾燥した反応ガスが副導入口１３よりガス通流溝６の中間部分へと導入され、ガス入口１１より導入された反応ガスの流れと合流して下流側へと流れ、ガス出口１２より排出される。したがって、本構成においては、副導入口１３より導入される乾燥した反応ガスによって、ガス通流溝６を流れる反応ガスの水蒸気分圧が低下するので、水の凝縮が抑制され、凝縮水のガス通流溝６の壁面への付着、滞留や流露の閉塞が回避されるので、安定した電池特性が得られる。

【００１４】なお、固体高分子電解質型燃料電池は運転中にセルの温度が変動する場合には、反応ガスの加湿条件を調整することにより電池出力を安定に維持することができる。図４のごとき従来の構成では反応ガスの加湿条件を急速に変化させることは困難であるが、本実施例

のごとく、副導入口１３より第２の反応ガスを導入することとし、適量に加湿された反応ガスを導入して流量を調整すれば、加湿条件の調整が容易となるので、水の凝縮が抑制さればかりでなく、セル温度の変動にも容易に追随する安定な電池特性が得られる。

【００１５】＜実施例２＞図２は、本発明による固体高分子電解質型燃料電池の実施例２のセルのセパレータに形成されたガス流路の形状を示す断面図である。本実施例のセパレータ５Ｂに備えられたガス流路の特徴は、ガス入口１１とガス通流溝６の中間部分との間に分岐通流溝１４を備え、反応ガスの一部を分流して分岐導入口１５よりガス通流溝６の中間部分へと供給するよう構成した点にある。本構成では、ガス通流溝６を通流して電気化学反応により生成水が生じて反応ガス中の水分量が増加しても、分岐導入口１５より導入された反応ガスによって水分量が低減され、溝内への水の凝縮が抑制される。特に、アノード側の電極に対向する反応ガス通流溝６に加湿した反応ガスを、またカソード側の電極に対向する反応ガス通流溝６に乾燥した反応ガスを供給することとすれば、アノード側は一定して加湿状態が保持され、カソード側は電気化学反応に伴い生じる生成水により加湿され、かつ、反応ガス通流溝の中間部分より導入される反応ガスによって水分量の増大が抑えられるので、水の凝縮の抑制に特に効果的である。

【００１６】

【発明の効果】上述のように、本発明によれば、平板状の固体高分子電解質膜の両主面に電極を配して形成された電解質膜電極接合体と、電解質膜電極接合体の電極に対向して反応ガス通流溝を備えたガス不透過性材料よりなるセパレータを積層して構成し、セパレータに備えたガス入口より反応ガスを導入し、反応ガス通流溝を通流させて電気化学反応により発電させ、セパレータに備えたガス出口より排出する固体高分子電解質型燃料電池において、

（１）セパレータに、前記の反応ガス通流溝の中間部分へと連通して第２の反応ガスを導入する副導入口を備え、乾燥した反応ガスあるいは加湿した反応ガスを導入することとしたので、発電に伴い生じる生成水の反応ガス通流溝への凝縮が効果的に抑制され、安定して電池出力が得られる固体高分子電解質型燃料電池が得られることとなった。

【００１７】（２）また、ガス入口と反応ガス通流溝の中間部分との間に、反応ガスを分流する分岐通流溝を備え、例えば、アノード側の電極に対向する反応ガス通流溝に加湿した反応ガスを、またカソード側の電極に対向する反応ガス通流溝に乾燥した反応ガスを通流することとしても、発電に伴う生成水の反応ガス通流溝への凝縮が抑制されるので、安定して電池出力が得られる固体高分子電解質型燃料電池として好適である。

【図面の簡単な説明】

【図１】本発明による固体高分子電解質型燃料電池の実施例１のセルのセパレータに形成されたガス流路の形状を示す断面図

【図２】本発明による固体高分子電解質型燃料電池の実施例２のセルのセパレータに形成されたガス流路の形状を示す断面図

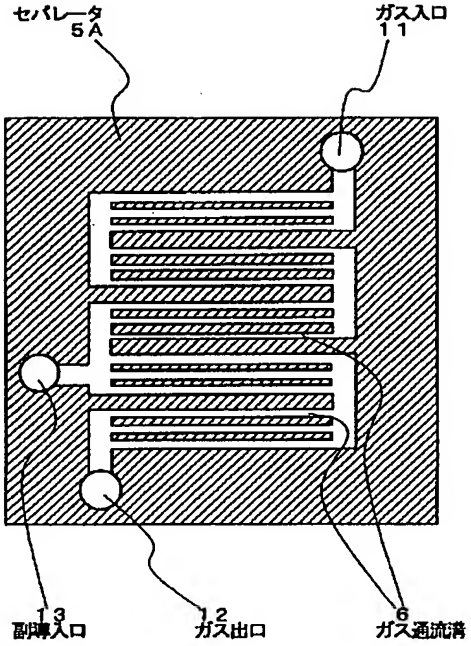
【図３】従来の固体高分子電解質型燃料電池のセル構造を示す断面図

【図４】図３のセルのセパレータに形成されているガス通流溝の形状を示す断面図

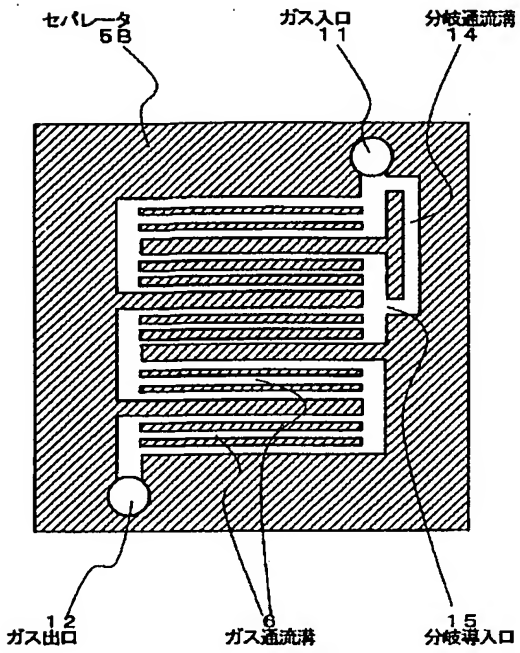
【符号の説明】

１　固体高分子電解質膜
２　電極触媒層
３　電極基材
４　電極
５　セパレータ
５Ａ，５Ｂ　セパレータ
６　ガス通流溝
９　電解質膜電極接合体
１１　ガス入口
１２　ガス出口
１３　副導入口
１４　分岐通流溝
１５　分岐導入口

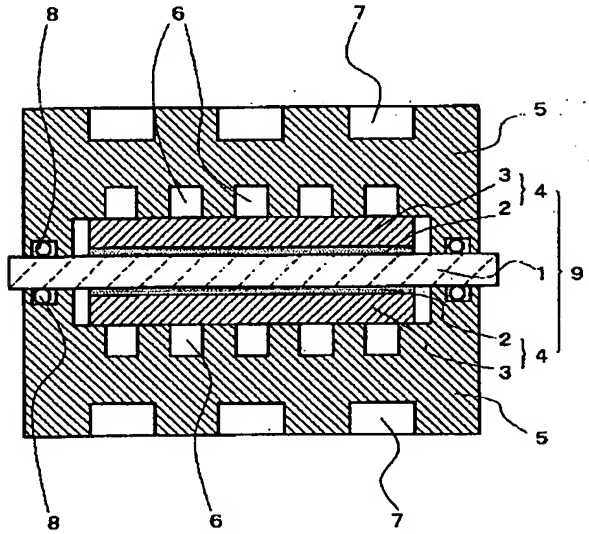
【図1】


セパレータ
5A
ガス入口
11
13
副導入口
12
ガス出口
6
ガス通流溝

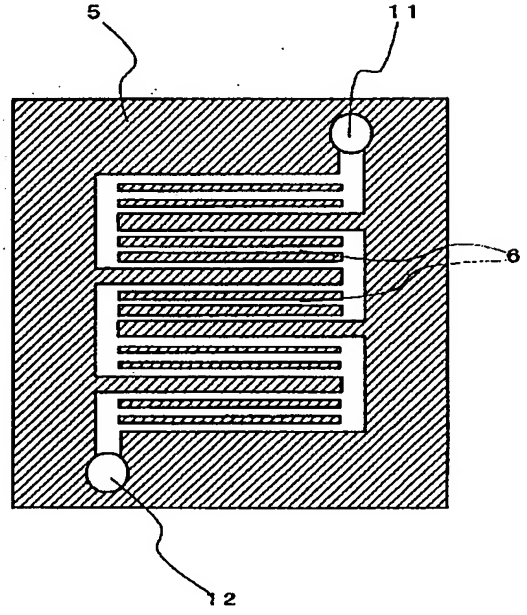
【図2】


セパレータ
5B
ガス入口
11
分岐通流溝
14
12
ガス出口
6
ガス通流溝
15
分岐導入口

【図3】


8
6
7
5
3
2
4
1
9
2
3
4
5
8
6
7

【図4】


5
11
6
12

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CLAIMS

[Claim(s)]
[Claim 1]An electrolyte membrane electrode conjugate which allotted an electrode to both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them.
An electrode of an electrolyte membrane electrode conjugate is countered and it is a reactant gas conduction slot.
It had a subfeed port which is the solid polyelectrolyte type fuel cell provided with the above, is open for free passage to a separator to an omitted portion of the aforementioned reactant gas conduction slot, and introduces the 2nd reactant gas into it.

[Claim 2]A solid polyelectrolyte type fuel cell being the reactant gas which the 2nd aforementioned reactant gas introduced from a subfeed port dried in the solid polyelectrolyte type fuel cell according to claim 1.
[Claim 3]A solid polyelectrolyte type fuel cell being the reactant gas which the 2nd aforementioned reactant gas introduced from a subfeed port humidified in the solid polyelectrolyte type fuel cell according to claim 1.
[Claim 4]An electrolyte membrane electrode conjugate which allotted an electrode to both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them.
An electrode of an electrolyte membrane electrode conjugate is countered and it is a reactant gas conduction slot.
It had a branching conduction slot which is the solid polyelectrolyte type fuel cell provided with the above, and carries out the diversion of river of the reactant gas between a gas inlet and an omitted portion of a reactant gas conduction slot.

[Claim 5]It is considered as reactant gas which humidified reactant gas made [a reactant gas conduction slot of a separator which counters an electrode by the side of an anode of an electrolyte membrane electrode conjugate] to carry out conduction in the solid polyelectrolyte type fuel cell according to claim 4, A solid polyelectrolyte type fuel cell considering it as reactant gas which dried reactant gas made [a reactant gas conduction slot of a separator which counters an electrode by the side of a cathode] to carry out conduction.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the composition of the channel of the reactant gas which forms solid polyelectrolyte membrane in the cellular structure of the solid polyelectrolyte type fuel cell used as an electrolyte, especially a separator.
[0002]
[Description of the Prior Art]A solid polyelectrolyte type fuel cell arranges an anode electrode and a cathode terminal on the two principal surfaces of solid polyelectrolyte membrane, respectively, and is formed in them. On an electrode substrate, each of anodes and cathode terminals allots an electrode catalyst layer, and is formed, and the thing which uses the cation exchange membrane of a polystyrene system with a sulfonic group as a cation conductive film, or a perfluoro sulfonic-acid-type-resin film is used for solid polyelectrolyte membrane.
[0003]Solid polyelectrolyte membrane is at ordinary temperature by having a proton (hydrogen ion) exchange group in a molecule, and carrying out water to saturation. The specific resistance below 20 omega-cm is shown, and it functions as a proton conductivity electrolyte. An electrode substrate is a porous body and functions as reactant gas supply of a fuel cell, an ejecting means, and a charge collector. In an anode and a cathode terminal, the three-phase zone of mind, liquid, and solid phase is formed, and the electrochemical reaction of a following formula (1) and (2) occurs by the catalysis of an electrode catalyst, respectively.
[0004]
[Formula 1]
Anode electrode ; $H_2=2H^++2e$ (1)

Cathode terminal ; (1/2) $O_2+2H^++2e=H_2O$ (2)

That is, in an anode electrode, a proton and an electron generate from H_2 gas supplied from the exterior of the system. The generated proton moves toward a cathode terminal in the inside of an ion-exchange membrane, and an electron moves to a cathode terminal through an external circuit. On the other hand, in a cathode terminal, O_2 gas supplied from the exterior of the system, and the proton which has moved from the anode electrode in the inside of an ion-exchange membrane and the electron which has moved from the external circuit react, and H_2O is generated.

[0005]Drawing 3 is a sectional view showing the cellular structure of the conventional solid polyelectrolyte type fuel cell. On the electrode substrate 3, the electrode catalyst layer 2 is laminated and the electrode 4 is constituted. The electrode 4 is arranged to the both principal planes of the solid polyelectrolyte membrane 1, it bonds by thermo-compression with a hotpress, and the electrolyte membrane electrode conjugate 9 is formed. Thus, the electrolyte membrane electrode conjugate 9 in which the electrode 4 has been arranged is pinched to the solid polyelectrolyte membrane 1 with the separator 5 laminated by both sides, and is fixed to it. The separator 5 machines carbon plate material

and is formed.
It has the reactant gas conduction slot 6 and the cooling water conduction slot 7.
the reactant gas conduction slot 6 of the separator 5 by the side of an anode electrode -- fuel gas (hydrogen gas) -- oxidant gas (air) is passed in the reactant gas conduction slot 6 of the separator 5 by the side of a cathode terminal. If the solid polyelectrolyte membrane 1 dries and moisture is lost, it will become high resistance, ohm loss will increase, and a battery characteristic will fall. For this reason, desiccation of the solid polyelectrolyte membrane 1 is prevented by supplying, after humidifying reactant gas. The separator 5 is equipped with the slot of gasket ******, and the disclosure to the battery exterior of reactant gas is prevented by equipping with the gasket 8.
[0006]Generally porous carbon paper is used for the electrode substrate 3 which constitutes the electrode 4.
If fuel gas or oxidant gas is supplied to the reactant gas conduction slot 6, these reactant gas will diffuse the inside of the electrode substrate 3, will reach to the electrode catalyst layer 2, and will produce above-mentioned electrochemical reaction.
A current is collected with the electrode substrate 3, and further, through the separator 5, the electron generated according to electrochemical reaction is outputted to an external circuit, and is consumed.
[0007]Drawing 4 is a sectional view showing the shape of the gas passageway currently formed in the separator 5 of the above-mentioned cell. After introducing reactant gas from the gas inlet 11 allotted to the upper part of the separator 5, carrying out conduction of the gas conduction slot 6 allotted to the power generation region corresponding to the electrode 4 of the electrolyte membrane electrode conjugate 9 to a lower part, producing electrochemical reaction and contributing to power generation, residual gas is discharged from the gas outlet 12 outside.
[0008]
[Problem(s) to be Solved by the Invention]Since electrochemical reaction is produced and reactant gas is consumed as it goes to the gas outlet 12 from the gas inlet 11, a flow decreases and the rate of flow falls. In the separator 5 by the side of the cathode with which the air or oxygen gas of an oxidizer is supplied, since produced water accumulates as water is generated in connection with electrochemical reaction and it goes to the downstream, in the field near the gas outlet 12, it becomes easy to condense water. Since the rate of flow of gas also falls by the downstream still as mentioned above, there is a danger that the phenomenon of the gas conduction slot 6 being blockaded with the condensed produced water, or adhering to the wall surface of a water fang furrow, and stagnating will arise. Thus, since the electrode substrate 3 or the electrode catalyst layer 2 which constitutes the electrode 4 will get wet in water and the hole of a porous body will be covered with water if it will be in the state where water condenses into the gas conduction slot 6, diffusion of the reactant gas to the electrode catalyst layer 2 will be checked, and the situation where a battery characteristic falls will occur.
[0009]The purpose of this invention is to provide the solid polyelectrolyte type fuel cell with which the condensation to the reactant gas conduction slot of the produced water produced with power generation is effectively controlled, is stabilized, and a cell output is obtained.
[0010]
[Means for Solving the Problem]In this invention in order to attain the above-mentioned purpose, An electrolyte membrane electrode conjugate which allotted an electrode to both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them, A separator which consists of gas impermeability material which countered an electrode of an electrolyte membrane electrode conjugate and was provided with a reactant gas conduction slot is laminated and constituted, In a solid polyelectrolyte type fuel cell discharged from a gas outlet which introduced reactant gas, carried out conduction of the reactant gas conduction slot, and made generate according to electrochemical reaction, and with which a separator was equipped from a gas inlet with which a separator was equipped, (1) Suppose that it has a subfeed port which is open for free passage to a separator to an omitted portion of the aforementioned reactant gas conduction slot, and introduces the 2nd reactant gas into it, and dry reactant gas or humidified reactant gas is introduced.
[0011](2) Or it has a branching conduction slot which carries out the diversion of river of the reactant

gas between a gas inlet and an omitted portion of a reactant gas conduction slot, For example, suppose that conduction of the reactant gas which dried reactant gas humidified into a reactant gas conduction slot which counters an electrode by the side of an anode into a reactant gas conduction slot which counters an electrode by the side of a cathode again is carried out.
Since water generated in connection with electrochemical reaction will be held as a steam if reactant gas which provided a subfeed port and was dried as the 2nd reactant gas as shown in above (1) is supplied, condensation of water is prevented and a fall of a battery characteristic is avoided. Since humidification conditions of a reactant gas conduction slot can be easily fluctuated by adjustment of this reactant gas if reactant gas humidified as the 2nd reactant gas is supplied, Condensation of water is prevented, and even if a fall of a battery characteristic is not only avoided, but change of cell temperature arises, it becomes possible to maintain a stable output easily.
[0012]As shown in above (2), it has a branching conduction slot, and condensation of water will be controlled by introduction of reactant gas with few moisture contents if reactant gas shunted toward an omitted portion of a reactant gas conduction slot is supplied. If reactant gas which dried reactant gas humidified into a reactant gas conduction slot which counters an electrode by the side of an anode especially in a reactant gas conduction slot which counters an electrode by the side of a cathode again is supplied, The anode side is fixed, and a humidified state is held, and, on the other hand, in the cathode side. Residual reactant gas is discharged outside, without producing a blockade by the water of condensation of a gas conduction slot, adhesion on a wall surface of a slot on the water of condensation, and stagnation, since condensation of water is controlled by reactant gas which is humidified with produced water produced in connection with electrochemical reaction, and is introduced from an omitted portion of a reactant gas conduction slot.
[0013]
[Embodiment of the Invention]
<Example 1> drawing 1 is a sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 1 of the solid polyelectrolyte type fuel cell by this invention. The feature of the gas passageway with which the separator 5A of this example was equipped is at the point of having the subfeed port 13 which is open for free passage to the omitted portion of the gas conduction slot 6. In this composition, the humidified reactant gas is introduced from the gas inlet 11, carries out conduction of the gas conduction slot 6 moved in a zigzag direction and allotted corresponding to the polar zone, and is discharged from the gas outlet 12. Simultaneously, reactant gas dry as the 2nd reactant gas joins the flow of the reactant gas which was introduced from the subfeed port 13 to the omitted portion of the gas conduction slot 6, and was introduced from the gas inlet 11, flows into the downstream, and is discharged from the gas outlet 12. Therefore, since the steam partial pressure of the reactant gas which flows through the gas conduction slot 6 falls in this composition with the dry reactant gas introduced from the subfeed port 13, Since condensation of water is controlled and adhesion on the wall surface of the gas conduction slot 6 on the water of condensation, and stagnation and the blockade of a channel are avoided, the stable battery characteristic is obtained.
[0014]The solid polyelectrolyte type fuel cell can maintain a cell output stably by adjusting the humidification conditions of reactant gas, when changing the temperature of a cell during operation. Although it is difficult to change the humidification conditions of reactant gas quickly with the conventional composition like drawing 4, Since adjustment of humidification conditions will become easy if it supposes that the 2nd reactant gas is introduced, the reactant gas humidified by optimum dose is introduced and a flow is adjusted from the subfeed port 13 like this example, the stable battery characteristic which condensation of water is controlled and follows in footsteps of change of cell temperature instead of foolish ** easily is obtained.
[0015]<Example 2> drawing 2 is a sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 2 of the solid polyelectrolyte type fuel cell by this invention. The feature of the gas passageway with which the separator 5B of this example was equipped is provided with the branching conduction slot 14 between the gas inlet 11 and the omitted portion of the gas conduction slot 6, and is that it constituted so that a part of reactant gas might be shunted and the

omitted portion of the gas conduction slot 6 might be supplied from the branching feed port 15. In this composition, even if conduction of the gas conduction slot 6 is carried out, produced water arises according to electrochemical reaction and the moisture content in reactant gas increases, by the reactant gas introduced from the branching feed port 15, a moisture content is reduced and condensation of the water to Mizouchi is controlled. If the reactant gas which dried the reactant gas humidified into the reactant gas conduction slot 6 which counters the electrode by the side of an anode especially into the reactant gas conduction slot 6 which counters the electrode by the side of a cathode again is supplied, Since increase of a moisture content is suppressed by the reactant gas which the anode side is fixed, a humidified state is held, and the cathode side is humidified with the produced water produced in connection with electrochemical reaction, and is introduced from the omitted portion of a reactant gas conduction slot, it is effective for especially control of condensation of water.

[0016]

[Effect of the Invention]As mentioned above, the electrolyte membrane electrode conjugate which according to this invention allotted the electrode to the both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them, The separator which consists of gas impermeability material which countered the electrode of the electrolyte membrane electrode conjugate and was provided with the reactant gas conduction slot is laminated and constituted, In the solid polyelectrolyte type fuel cell discharged from the gas outlet which introduced reactant gas, carried out conduction of the reactant gas conduction slot, and made generate according to electrochemical reaction, and with which the separator was equipped from the gas inlet with which the separator was equipped, (1) Since it has a subfeed port which is open for free passage to a separator to the omitted portion of the aforementioned reactant gas conduction slot, and introduces the 2nd reactant gas into it and dry reactant gas or the humidified reactant gas is introduced, The solid polyelectrolyte type fuel cell with which the condensation to the reactant gas conduction slot of the produced water produced with power generation is effectively controlled, is stabilized, and a cell output is obtained will be obtained.

[0017](2) It has a branching conduction slot which carries out the diversion of river of the reactant gas between a gas inlet and the omitted portion of a reactant gas conduction slot, For example, also as carrying out conduction of the reactant gas which dried the reactant gas humidified into the reactant gas conduction slot which counters the electrode by the side of an anode into the reactant gas conduction slot which counters the electrode by the side of a cathode again, Since the condensation to the reactant gas conduction slot of the produced water accompanying power generation is controlled, it is suitable as a solid polyelectrolyte type fuel cell with which it is stabilized and a cell output is obtained.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the composition of the channel of the reactant gas which forms solid polyelectrolyte membrane in the cellular structure of the solid polyelectrolyte type fuel cell used as an electrolyte, especially a separator.

[Translation done.]

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PRIOR ART

[Description of the Prior Art]A solid polyelectrolyte type fuel cell arranges an anode electrode and a cathode terminal on the two principal surfaces of solid polyelectrolyte membrane, respectively, and is formed in them. On an electrode substrate, each of anodes and cathode terminals allots an electrode catalyst layer, and is formed, and the thing which uses the cation exchange membrane of a polystyrene system with a sulfonic group as a cation conductive film, or a perfluoro sulfonic-acid-type-resin film is used for solid polyelectrolyte membrane.
[0003]Solid polyelectrolyte membrane is at ordinary temperature by having a proton (hydrogen ion) exchange group in a molecule, and carrying out water to saturation. The specific resistance below 20 omega-cm is shown, and it functions as a proton conductivity electrolyte. An electrode substrate is a porous body and functions as reactant gas supply of a fuel cell, an ejecting means, and a charge collector. In an anode and a cathode terminal, the three-phase zone of mind, liquid, and solid phase is formed, and the electrochemical reaction of a following formula (1) and (2) occurs by the catalysis of an electrode catalyst, respectively.
[0004]
[Formula 1]
Anode electrode ; $H_2=2H^++2e$ (1)

Cathode terminal ; (1/2) $O_2+2H^++2e=H_2O$ (2)

That is, in an anode electrode, a proton and an electron generate from H_2 gas supplied from the exterior of the system. The generated proton moves toward a cathode terminal in the inside of an ion-exchange membrane, and an electron moves to a cathode terminal through an external circuit. On the other hand, in a cathode terminal, O_2 gas supplied from the exterior of the system, and the proton which has moved from the anode electrode in the inside of an ion-exchange membrane and the electron which has moved from the external circuit react, and H_2O is generated.

[0005]Drawing 3 is a sectional view showing the cellular structure of the conventional solid polyelectrolyte type fuel cell. On the electrode substrate 3, the electrode catalyst layer 2 is laminated and the electrode 4 is constituted. The electrode 4 is arranged to the both principal planes of the solid polyelectrolyte membrane 1, it bonds by thermo-compression with a hotpress, and the electrolyte membrane electrode conjugate 9 is formed. Thus, the electrolyte membrane electrode conjugate 9 in which the electrode 4 has been arranged is pinched to the solid polyelectrolyte membrane 1 with the separator 5 laminated by both sides, and is fixed to it. The separator 5 machines carbon plate material and is formed.
It has the reactant gas conduction slot 6 and the cooling water conduction slot 7.
the reactant gas conduction slot 6 of the separator 5 by the side of an anode electrode -- fuel gas (hydrogen gas) -- oxidant gas (air) is passed in the reactant gas conduction slot 6 of the separator 5 by the side of a cathode terminal. If the solid polyelectrolyte membrane 1 dries and moisture is lost, it will become high resistance, ohm loss will increase, and a battery characteristic will fall. For this reason,

desiccation of the solid polyelectrolyte membrane 1 is prevented by supplying, after humidifying reactant gas. The separator 5 is equipped with the slot of gasket ******, and the disclosure to the battery exterior of reactant gas is prevented by equipping with the gasket 8.

[0006]Generally porous carbon paper is used for the electrode substrate 3 which constitutes the electrode 4.

If fuel gas or oxidant gas is supplied to the reactant gas conduction slot 6, these reactant gas will diffuse the inside of the electrode substrate 3, will reach to the electrode catalyst layer 2, and will produce above-mentioned electrochemical reaction.

A current is collected with the electrode substrate 3, and further, through the separator 5, the electron generated according to electrochemical reaction is outputted to an external circuit, and is consumed.

[0007]Drawing 4 is a sectional view showing the shape of the gas passageway currently formed in the separator 5 of the above-mentioned cell. After introducing reactant gas from the gas inlet 11 allotted to the upper part of the separator 5, carrying out conduction of the gas conduction slot 6 allotted to the power generation region corresponding to the electrode 4 of the electrolyte membrane electrode conjugate 9 to a lower part, producing electrochemical reaction and contributing to power generation, residual gas is discharged from the gas outlet 12 outside.

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EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, the electrolyte membrane electrode conjugate which allotted the electrode to the both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them in this invention, The separator which consists of gas impermeability material which countered the electrode of the electrolyte membrane electrode conjugate and was provided with the reactant gas conduction slot is laminated and constituted, In the solid polyelectrolyte type fuel cell discharged from the gas outlet which introduced reactant gas, carried out conduction of the reactant gas conduction slot, and made generate according to electrochemical reaction, and with which the separator was equipped from the gas inlet with which the separator was equipped, (1) We decided to have a subfeed port which is open for free passage to a separator to the omitted portion of the aforementioned reactant gas conduction slot, and introduces the 2nd reactant gas into it, and to introduce dry reactant gas or the humidified reactant gas.
Therefore, the solid polyelectrolyte type fuel cell with which the condensation to the reactant gas conduction slot of the produced water produced with power generation is effectively controlled, is stabilized, and a cell output is obtained will be obtained.

[0017](2) It has a branching conduction slot which carries out the diversion of river of the reactant gas between a gas inlet and the omitted portion of a reactant gas conduction slot, For example, also as carrying out conduction of the reactant gas which dried the reactant gas humidified into the reactant gas conduction slot which counters the electrode by the side of an anode into the reactant gas conduction slot which counters the electrode by the side of a cathode again, Since the condensation to the reactant gas conduction slot of the produced water accompanying power generation is controlled, it is suitable as a solid polyelectrolyte type fuel cell with which it is stabilized and a cell output is obtained.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]Since electrochemical reaction is produced and reactant gas is consumed as it goes to the gas outlet 12 from the gas inlet 11, a flow decreases and the rate of flow falls. In the separator 5 by the side of the cathode with which the air or oxygen gas of an oxidizer is supplied, since produced water accumulates as water is generated in connection with electrochemical reaction and it goes to the downstream, in the field near the gas outlet 12, it becomes easy to condense water. Since the rate of flow of gas also falls by the downstream still as mentioned above, there is a danger that the phenomenon of the gas conduction slot 6 being blockaded with the condensed produced water, or adhering to the wall surface of a water fang furrow, and stagnating will arise. Thus, since the electrode substrate 3 or the electrode catalyst layer 2 which constitutes the electrode 4 will get wet in water and the hole of a porous body will be covered with water if it will be in the state where water condenses into the gas conduction slot 6, diffusion of the reactant gas to the electrode catalyst layer 2 will be checked, and the situation where a battery characteristic falls will occur.
[0009]The purpose of this invention is to provide the solid polyelectrolyte type fuel cell with which the condensation to the reactant gas conduction slot of the produced water produced with power generation is effectively controlled, is stabilized, and a cell output is obtained.

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MEANS

[Means for Solving the Problem]In this invention in order to attain the above-mentioned purpose, An electrolyte membrane electrode conjugate which allotted an electrode to both principal planes of plate-like solid polyelectrolyte membrane, and was formed in them, A separator which consists of gas impermeability material which countered an electrode of an electrolyte membrane electrode conjugate and was provided with a reactant gas conduction slot is laminated and constituted, In a solid polyelectrolyte type fuel cell discharged from a gas outlet which introduced reactant gas, carried out conduction of the reactant gas conduction slot, and made generate according to electrochemical reaction, and with which a separator was equipped from a gas inlet with which a separator was equipped, (1) Suppose that it has a subfeed port which is open for free passage to a separator to an omitted portion of the aforementioned reactant gas conduction slot, and introduces the 2nd reactant gas into it, and dry reactant gas or humidified reactant gas is introduced.
[0011](2) Or it has a branching conduction slot which carries out the diversion of river of the reactant gas between a gas inlet and an omitted portion of a reactant gas conduction slot, For example, suppose that conduction of the reactant gas which dried reactant gas humidified into a reactant gas conduction slot which counters an electrode by the side of an anode into a reactant gas conduction slot which counters an electrode by the side of a cathode again is carried out.
Since water generated in connection with electrochemical reaction will be held as a steam if reactant gas which provided a subfeed port and was dried as the 2nd reactant gas as shown in above (1) is supplied, condensation of water is prevented and a fall of a battery characteristic is avoided. Since humidification conditions of a reactant gas conduction slot can be easily fluctuated by adjustment of this reactant gas if reactant gas humidified as the 2nd reactant gas is supplied, Condensation of water is prevented, and even if a fall of a battery characteristic is not only avoided, but change of cell temperature arises, it becomes possible to maintain a stable output easily.
[0012]As shown in above (2), it has a branching conduction slot, and condensation of water will be controlled by introduction of reactant gas with few moisture contents if reactant gas shunted toward an omitted portion of a reactant gas conduction slot is supplied. If reactant gas which dried reactant gas humidified into a reactant gas conduction slot which counters an electrode by the side of an anode especially in a reactant gas conduction slot which counters an electrode by the side of a cathode again is supplied, The anode side is fixed, and a humidified state is held, and, on the other hand, in the cathode side. Residual reactant gas is discharged outside, without producing a blockade by the water of condensation of a gas conduction slot, adhesion on a wall surface of a slot on the water of condensation, and stagnation, since condensation of water is controlled by reactant gas which is humidified with produced water produced in connection with electrochemical reaction, and is introduced from an omitted portion of a reactant gas conduction slot.
[0013]
[Embodiment of the Invention]
<Example 1> drawing 1 is a sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 1 of the solid polyelectrolyte type fuel cell by this invention. The

feature of the gas passageway with which the separator 5A of this example was equipped is at the point of having the subfeed port 13 which is open for free passage to the omitted portion of the gas conduction slot 6. In this composition, the humidified reactant gas is introduced from the gas inlet 11, carries out conduction of the gas conduction slot 6 moved in a zigzag direction and allotted corresponding to the polar zone, and is discharged from the gas outlet 12. Simultaneously, reactant gas dry as the 2nd reactant gas joins the flow of the reactant gas which was introduced from the subfeed port 13 to the omitted portion of the gas conduction slot 6, and was introduced from the gas inlet 11, flows into the downstream, and is discharged from the gas outlet 12. Therefore, since the steam partial pressure of the reactant gas which flows through the gas conduction slot 6 falls in this composition with the dry reactant gas introduced from the subfeed port 13, Since condensation of water is controlled and adhesion on the wall surface of the gas conduction slot 6 on the water of condensation, and stagnation and the blockade of a channel are avoided, the stable battery characteristic is obtained.

[0014]The solid polyelectrolyte type fuel cell can maintain a cell output stably by adjusting the humidification conditions of reactant gas, when changing the temperature of a cell during operation. Although it is difficult to change the humidification conditions of reactant gas quickly with the conventional composition like drawing 4, Since adjustment of humidification conditions will become easy if it supposes that the 2nd reactant gas is introduced, the reactant gas humidified by optimum dose is introduced and a flow is adjusted from the subfeed port 13 like this example, the stable battery characteristic which condensation of water is controlled and follows in footsteps of change of cell temperature instead of foolish ** easily is obtained.

[0015]<Example 2> drawing 2 is a sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 2 of the solid polyelectrolyte type fuel cell by this invention. The feature of the gas passageway with which the separator 5B of this example was equipped is provided with the branching conduction slot 14 between the gas inlet 11 and the omitted portion of the gas conduction slot 6, and is that it constituted so that a part of reactant gas might be shunted and the omitted portion of the gas conduction slot 6 might be supplied from the branching feed port 15. In this composition, even if conduction of the gas conduction slot 6 is carried out, produced water arises according to electrochemical reaction and the moisture content in reactant gas increases, by the reactant gas introduced from the branching feed port 15, a moisture content is reduced and condensation of the water to Mizouchi is controlled. If the reactant gas which dried the reactant gas humidified into the reactant gas conduction slot 6 which counters the electrode by the side of an anode especially into the reactant gas conduction slot 6 which counters the electrode by the side of a cathode again is supplied, Since increase of a moisture content is suppressed by the reactant gas which the anode side is fixed, a humidified state is held, and the cathode side is humidified with the produced water produced in connection with electrochemical reaction, and is introduced from the omitted portion of a reactant gas conduction slot, it is effective for especially control of condensation of water.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 1 of the solid polyelectrolyte type fuel cell by this invention
[Drawing 2]The sectional view showing the shape of the gas passageway formed in the separator of the cell of Example 2 of the solid polyelectrolyte type fuel cell by this invention
[Drawing 3]The sectional view showing the cellular structure of the conventional solid polyelectrolyte type fuel cell
[Drawing 4]The sectional view showing the shape of the gas conduction slot currently formed in the separator of the cell of drawing 3
[Description of Notations]
1 Solid polyelectrolyte membrane
2 Electrode catalyst layer
3 Electrode substrate
4 Electrode
5 Separator
5A and 5B Separator
6 Gas conduction slot
9 Electrolyte membrane electrode conjugate
11 Gas inlet
12 Gas outlet
13 A subfeed port
14 Branching conduction slot
15 Branching feed port

[Translation done.]